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DISCUSSION OF AIRCRAFT DESIGN AS RELATED TO AIRPORT STANDARDS

(Published in October, 1951)

By John H. Geisse

AIR TRANSPORT DIVISION

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DISCUSSION

JOHN H. GEISSE[2].—By his endorsement of the cross-wind undercarriage for airplanes (under the heading, "Aircraft Design") the author has earned the thanks of all those who pay for and use airports. By his persistence in the face of known opposition he is emulating his famous namesake, General "Hap" Arnold. It was the latter who, with equal foresightedness and courage, endorsed the tricycle undercarriage in 1934 against similar opposition.

There are interesting similarities between the two developments which are probably not well known. Both the cross-wind gear and the tricycle gear antidated the so-called conventional gear with two fixed wheels forward of the center of gravity. The tricycle gear was in general use some time prior to World War I and Louis Bleriot had a castered cross-wind undercarriage on his airplane which made the first crossing of the English Channel in 1909. The tricycle gear was reintroduced in 1933 by the Bureau of Air Commerce and the castered gear was reintroduced by its successor, the CAA, in 1945.

There is also one important dissimilarity. In 1934, the Bureau of Air Commerce abandoned its promotion of the tricycle gear and stopped work on two contracts for airplanes with castered wheels. Although there was a determined opposition to the action, in 1949, the CAA abandoned—not the cross-wind gear but—the construction of any more airports of the windrose type.

The loss to the taxpayer and to the industry by this early abandonment of the cross-wind gear will never be fully appreciated. Under the heading, "Airport Requirements," the author states that the land areas required for multiple-runway airports has forced their construction in outlying areas. He also stated that the great untapped market for commercial aviation lies in the short-haul field of 1,000 miles or less. He was being ultra-conservative in this statement. Even under present conditions the average air-line trip is only about 450 miles. The great untapped market is in still shorter hauls, and the ability of the airplane to compete with other means of transportation over these short distances is wholly a function of the distance of the airports from the population centers. Percentagewise, it can save just as much time over short hauls as over long hauls if time to and from the airport does not have to be considered.

The author's argument can be well illustrated by one example: The distance from Chicago, Ill., to Cleveland, Ohio, is not much less than the present trip average; yet between these two cities a DC-3 operating between downtown airstrips could provide faster and cheaper transportation than supersonic airplanes operating between the existing airports.

Perhaps even more pronounced has been the effect of this abandonment on private flying. In 1940 the CAA made two studies of private flying. One

NOTE.—This paper by Milton W. Arnold was published in October, 1951, as *Proceedings-Separate No. 93*. The numbering of footnotes in this Separate is a continuation of the consecutive numbering used in the original paper.

[2] Cons. Engr., Washington, D. C.

disclosed that only 15% of those who started flying continued with it. The other disclosed that the major reason for this poor showing was the inaccessability of airports. This was a combination of airports too far out and airports completely nonexistent because of their high cost.

More tangible than the foregoing example is the sum of money that was spent needlessly on airports between 1935 and 1945. In this period approximately $800,000,000 was spent on the construction of civil airports alone. Some years ago the writer studied the distribution of costs on all classes of airports and found that an average saving of 50% could be made by eliminating wind coverage. Assuming this cost to be twice too high, the saving that could have been made ($200,000,000) would have been more than the present net value of all the flight equipment of all domestic airlines operating in the United States.

The author states (under the heading, "Installation of Equipment: Airborne Equipment") that it costs $6,250 per year to transport 100 lb of equipment in one airline aircraft. This factor must be given consideration when recommending any alteration in this equipment. However, it is quite possible that adding a cross-wind gear in the original design can subtract weight. In all transport equipment, the wheels are mounted on collapsible shock struts which can provide perfectly good caster spindles if the wheels are in caster relationship therewith. The added weight would then be the weight of a caster restraint and shimmy damping mechanism, less the weight of the jackknives now used to prevent rotation in the strut.

As against this slight increase in weight a substantial decrease in the weight of the entire landing gear would be made possible by the reduction in the side loads on the gear. With castered wheels this side load needs to be only that required for adequate taxi control—not more than one third the weight of the airplane. With fixed wheels the entire undercarriage, including the wheels, must be designed to take an inwardly directed side load equal to 0.8 times the verticle load and an outwardly directed side load of 0.6 times the verticle.

The paper presents such an excellent argument for the advantages to be gained by the use of omnidirectional airports that one may wonder what are the disadvantages that have delayed their acceptance. As far as the writer is aware there are none.

There are two major reasons for the delay. One is the question of which should come first, the change in the airports or the change in the airplanes: Why build an airport adapted primarily to a nonexistent airplane? Why build an airplane to use airports that do not exist? The other reason, and a cogent one, is that any added costs of the conversion must be paid for by the airplane owners whereas the immediate savings go to the airport owners. In view of this situation the fact that the savings would far exceed the costs has little weight.

Opposition to initiating the change in the airports stemmed from various roots. There were the owners of airplanes who thought that the taxpayer and others should continue their airport subsidization of their flying rather than ask them to spend some of their money to make this unnecessary. Then

there were those who, politically or otherwise, had no desire to see the cost of airports drastically reduced.

In the face of this opposition the Civil Aeronautics Administrator in 1949 made his courageous decision to refuse any further federal funds for the construction of runways whose only purpose was to provide wind coverage. The effect of this decision will become evident only as new airports are constructed but it is to be hoped that the author's endorsement of the cross-wind undercarriage will hasten its consideration by the airplane manufacturers and users. These airports will be constructed and in use long before airplanes now on order, or on the drawing board, have been retired.

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